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EFFECT OF WHEAT BRAN INCORPORATION ON PHYSICOCHEMICAL PROPERTIES OF SWEET AND SALTY BISCUITS

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ABSTRACT

Wheat bran, a by-product of wheat processing. It has relatively various applications in food industries due to its richness in polysaccharides carbohydrates, (dietary fiber), a protein which makes it a vital dietary element. Wheat bran and refined wheat flour were analyzed for their proximate composition, water and oil absorption capacity and emulsion capacity. Data showed that wheat bran had a high amount of moisture, ash, protein and carbohydrate (7.85, 5.53, 12.55 and 73.71 respectively). Biscuits prepared from blends containing different proportions (0, 6, 8 and 10%) of wheat bran were also evaluated for chemical, physical characteristics and sensory evaluation. Data revealed that incorporation of wheat bran in biscuit making increased moisture content from3. 14 to 4.94, ash content ranged from 2.73 to 3.91 and 7.26 to 8.03 for protein, while fat, carbohydrate and energy values decreased significantly as increase the level of incorporation. The thickness of wheat bran substituted biscuits not affected significantly, whereas diameter and spread ratio decreased with increasing levels of wheat bran. The highly acceptable biscuits could be obtained by incorporating 10% wheat bran in the formulation.

***KEYWORDS:** Wheat Bran, Biscuits & Functional Properties*

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Original Article

INTRODUCTION

Bakery industry is the one of the largest food industry in India with an estimated production of 70,000 tones and cost of Rs.3000 billion US Dollar. The industry has been growing at an average rate of 15% during the past three years and this is expected to be maintained in the coming year (IBMA, 2010). The major products within this industry include bread, biscuits, cakes and pastry (Chough et.al. 2013). The demand of bakery products is increasing at a rate of 10.07% per annum (Kamaljitet.al, 2010). In India, biscuits consumption per capita is 2.1 kg., compared to more than 10 kg in the USA, UK and west European countries and above 4.25 kg in southeast Asian countries, e.g. Singapore, Hong Kong, Thailand, Indonesia, etc. China has a per capita consumption of 1.90 kg, while in the case of japan it is estimated at 7.5 kg (srivastava, 2009). Bread and biscuits from the major baked products accounting for over 80% of total bakery foods produced in the country. Bakery products are gaining extreme popularity as processed foods which offer ready to eat convenience as well as have comparatively long shelf life.

Developments of new products with substantial DF contents are a strategic area for the Bakery industry. Dietary fibers are a common and important ingredient of a new generation of healthy food products

(Schleibinger, M. *et al*. 2013). The dietary fiber content of bakery products may be increased by adding various substances from plant kingdom rich in dietary fiber (kamaljit, K. *et al.* 2011). Dietary fiber has received attention from researcher due to their functional properties such as water holding capacity, oil holding capacity, texturizing, stabilizing, gel forming capacity, antioxidant capacity, swelling capacity, viscosity, synergism with sweetener and fat replacement properties, etc. (Elleuch et al., 2011) derived from different sources; cereal, fruits and vegetables, have created a renewed interest in fiber particularly in the bakery industry. Many of the fiber supplements which have been researched are obtained from by-products resulting from the processing of cereals, fruits, vegetables, legumes and other agricultural products.

Wheat is one of the largest cereal grain crops in the world and second largest in the India. Wheat is the most important staple crop of temperate zones and is in increasing demand in countries undergoing urbanization and industrialization. In addition to being a major source of starch and energy, wheat also provides a substantial amount of a number of components which are essential or beneficial for health. Notably, protein, vitamins (B group) dietary fiber and phytochemical. Of these, wheat is an important source of dietary fiber (Shewryand Hey, 2015). Wheat bran is generated as a by-product in wheat milling industries (Hemery et.al., 2007). One million tons of wheat can produce up to 0.25 million tons of wheat bran (WB) (Javed et.al., 2012). Wheat bran is a rich source of carbohydrates (60%), protein (12%), fat (.5%) minerals (2%) (slavin, 2003) and total dietary fiber (54.2%) (Susulski and Wu, 1988).

Hence, the present study was designed to evaluate the proximate composition and functional properties of wheat bran and the effect of their incorporation at different levels (0-10%) on chemical, organoleptic, physical and functional characteristics of biscuits

MATERIALS AND METHODS

Preparation of Raw Materials: Control biscuits were prepared by using the rubbing method as given by kamaliya (2002). The following ingredients, wheat flour, baking soda, milk powder, sugar and shortening were purchased from priyedarshani market Jabalpur. Wheat bran was directly collected as left from Govt. M.H. College Hostel Jabalpur.

Table 1: Biscuits Formulation with Various Percentage of Wheat Bran

Ingredients (g)	WBB1%	WBB2	WBB3	WBB4
Refined wheat flour	100	94	92	90
Wheat bran (WB)	0	6	8	10
Powdered sugar	12	12	12	12
Shortening	40	40	40	40
Skimmed milk powder	5.0	5.0	5.0	5.0
Baking powder	1.5	1.5	1.5	1.5
Ammonium bicarbonate	1.5	1.5	1.5	1.5
Common salt	2.5	2.5	2.5	2.5
Ajwain	1.5	1.5	1.5	1.5

WBB1= biscuits with 100% refined wheat flour

WBB2= biscuits with 6% wheat bran

WBB3= biscuits with 8% wheat bran

WBB4= biscuits with 10% wheat bran

Weighing of ingredients
↓
Sieve flour
↓
Add shortening and rubbing
↓
Add sugar and mix lightly
↓
Mix water and make smooth dough
↓
Rolling / sheeting (4 mm)
↓
Cutting
↓
Tray greasing
↓
Baking (150 °C for 15 min.)
↓
Cooling
↓
Packaging

Figure 1: Flow Diagram for Preparation of Biscuits

Functional Properties

Water absorption capacity, oil absorption capacity was determined by the method of Onwuka (2005), it was described by Ohizuaet. Al. in their article (2016) as follow :

One (1) gram of the sample was weighted into a 15 ml centrifuge tube and suspended it in 10 ml of distilled water. It was shaken on a platform rocker for one minute at room temperature. The sample was allowed to stand for 30 minutes and centrifuged at 1200 × g for 30 minutes. The volume of free water was read directly from the centrifuge tube.

$$\text{WAC (\%)} = \frac{\text{Amount of water added} - \text{free water}}{\text{Weight of sample}} \times \text{Density of water} \times 100$$

One gram of the flour sample was mixed with 10 ml of soybean oil in a graduated centrifuge tube and allowed to stand at room temperature for one hour. It was centrifuged at 1600 ×g for 20 minutes. The volume of free oil was recorded from centrifuge tube. The oil absorption capacity was expressed as ml of oil bound by 100 g of dried flour.

$$\text{OAC (\%)} = \frac{\text{Amount of Oil added} - \text{free Oil}}{\text{Weight of sample}} \times \text{Density of soybean Oil} \times 100$$

Emulsification Capacity (EC)

Emulsification capacity was determined according to the method described by kaushal et.al. (2012) with slight modified. Two grams of the sample were blended with 25 ml of distilled water at room temperature for 30 second. Thereafter, 10 ml of refined soybean oil was added and the blending continued for another 30 second before transferring in-to a centrifuge tube. Centrifugation was done at 640× g for five minutes. The oil separated from the sample after centrifuging was note directly from the tube. Emulsification capacity was descried as the amount of oil emulsified and held per gram of sample.

$$= \frac{\text{Height of emulsified layer}}{\text{Height of whole solution in the centrifuge tubes}} \times 100$$

Sensory Evaluation

Twenty four hours after preparation of biscuits organoleptic evaluation was performed. A total 20 semi-trained panelist were recruited from staff and students of the Govt. M.H College of home Sci. & Sci. For Women, Jabalpur. Each panelist evaluated all the samples prepared for each treatment in one session. Criteria for selection of panelist were that panelist were regular consumers of biscuits and were not allergic to any food. Panelist requested to evaluate color, taste, texture, flavor and overall acceptability on 9 points Hedonic scale using numerical values ranging from 1 to 9, where 1entitled disliked extremely and 9 represented liked extremely. Samples were identified with a code and presented in a random sequence to the panelist. The panelists were instructed to rinse their mouth with water after every product and not make comments during evaluation to prevent influencing other panelist. They were also asked to comment freely on the samples on the score card provided to them.

Physical Properties

Height / Thickeness

Thickness of biscuit was assessed by vernier calipers (AACC, 1967). Six biscuits were stacked one above the other and the average value was reported in millimeter.

Weight

Weight of biscuits was measured as average value of six individual biscuits with the help of electrical weighing balance Bala et.al. (2015). The average value for weight was recorded in grams.

Diameter

The diameter was measured by laying six biscuits edge to edge and measuring nearest mm. The biscuits were rotated 90° and their diameter remeasure as check determination. The average value of the diameter was expressed in millimeter (AACC, 1967).

Spread Ratio: According to AACC, (1967) the spread factor calculated by dividing the average value of the diameter (D) by average value of thickness (T) of biscuits.

Spread Factor: the percentage of spread factor was calculated by the following formula (silky et.al, 2014)

$$\%\ \text{spread factor} = \frac{\text{spread ratio of biscuits prepared from blend}}{\text{Spread ratio of biscuits prepared from control}} \times$$

Nutritional Quality

Protein, fat, ash, moisture carbohydrate and energy content of the biscuit were determined as per IS 7219: 1973(R S2010), IS 12711:1989(R 2010), IS 12711:1989 (R 2010), IS 1011:2002 (R 2009), IS 9497:1989 (R 1998), IS 1656 (2007) and IS 9487 (1980) respectively.

Statistical Analysis

The data were subjected to ANOVA and mean scores were separated using Duncan‘s multiple range test by SPSS version 16.0.

RESULTS AND DISCUSSIONS

Proximate Composition of Raw Materials: The proximate composition of refined wheat flour and wheat bran are shown in table 2. Refined wheat flour was found to contain 13.92% moisture, 0.72% ash, 11.38% protein, 1.40% fat and 72.58% carbohydrate. These results appear to be in agreement with those reported by (hussan et.al, 2013 and silky et.al 2014). While wheat bran was found to be 7.84% moisture , 5.53% ash, 12.37% protein, .55% fat and 72.58 carbohydrate. Sudha et.al (2007) reported mean values of 7.68% moisture, 5.70% ash, and 13.12% protein for wheat bran. These results were in agreement with the results obtained by Sudha et.al (2007).

Water Absorption Capacity: water absorption capacity for blends is given in table 3. The WAC ranged 86.66 to 125.29 for all floors. The WAC observed highest in WB10% (125.29) and lowest in refined wheat flour (86.66). From this study, wheat bran had highest WAC (199.47). it was probably due to the presence of non-starchy polysaccharides in wheat bran. The result suggested that the addition of wheat bran into refined wheat flour increased WAC significantly as compared to refined wheat flour. This could be due to the molecular structure of starch, which inhibits water absorption. Similar was reported by kamaljit et.al (2011).

Oil Absorption Capacity: OAC ranged between 88. 86 to 162.57 among all combinations of the blends. The flour with 10% WB had highest OAC (162.57) and lowest refined wheat flour (88.86). It is clear from the data that the OAC increased significantly with an increase in the proportion of wheat bran.

Emulsion Capacity: kaushl et.al (2012) stated that protein being a surface active agent which can form and stabilize an emulsion by creating electrostatic repulsion on the oil droplet surface. Emulsion capacity is shown in table 5. EC of various blends ranged between 54.76 to 62.09. The highest for WB10% (62.09) and lowest for refined wheat flour (54.76) were observed.

Influence of Wheat Bran on Proximate Composition of Formulated Biscuits Sample: The mean values for proximate analysis of all biscuits samples are shown in table 4. An evaluation of result it was found that there was an increase in moisture content in samples to increase the level of wheat bran from 2.14 to 4.94. The increase in ash content from 2.73 (control) to 3.91 (WB 10%) was due to the high percentage of mineral content in wheat bran (Stevenson et.al, 2012) and no significant differences were noticed between WB0%, (2.73) WB6% (2.91±.07) and WB8% (2.85) levels. Also increasing the percentage of WB resulted significantly increase protein in comparison to control (7.26) and value obtained were found to be 7.60, 7.75 and 8.03 to 6%, 8% and 10% of WB levels respectively. Significant decrease in fat, carbohydrate and energy value were also observed for supplemented biscuits; from 22.17 to 20.18; 64.7 to 62.94 and 487.37 to 465.5 respectively. The result reported above were in agreement with those reported by kuldip et.al (2014) and silky et.al (2014).

Influence on Physical Characteristics: biscuits prepared using 0%, 6%, 8% and 10% of wheat bran in the blends were evaluated for various physical characteristics. Incorporation of wheat bran decreased the diameter of the biscuits from 44.5 to 41.63 mm without much change in the thickness of the biscuits as shown in table 5. Hence the spread ratio decreased from 6.12 to 5.93. The weight of the biscuits decreased significantly the value ranged 9.78 to 9.03 but no

significant difference was seen between 0% to 8% and 6% to 10% incorporation of wheat bran.A Similar trend was also observed by sudha et.al (2007).

Influence on Organoleptic Quality of Biscuits: As seen in table 6, no significant differences were found in mean scores of color attribute between all groups of biscuits. However, biscuits made from WB6% had highest scores for taste parameter followed by control, WBB8% and WBB10% respectively. The biscuits fortified with 10% of WB scored maximum for a mean sense of texture and flavor and this could be due to the pleasant flavor of WB. Overall acceptability results showed that biscuits supplemented with 8% and 10% were not significantly different and these were the combinations preferred by the assessors.

Table 2: Proximate Composition of Raw Materials

Raw Materials	Moisture	Ash	Protein	Fat	Carbohydrate
Wheat bran	7.84±.52	5.53±.55	12.37±.54	.55±.08	73.71
Refined wheat flour	13.92±.07	.72±.24	11.38±.37	1.40±.44	72.58

[a]mean value ± standard deviation
[b]mean value marked with different superscript in the same column are significantly different at Duccan - p≤ 0.05

Table 3: Functional Properties of Blends

Blends	WAC	OAC	EC
Wheat bran 100%	199.47±1.84^{a}	333.00± 1.00^{a}	52.63±.87^{a}
Refined wheat flour 100%	86.66±17.78^{b}	88.86±2.15^{b}	54.76±.60^{ab}
WB 6%	116.92±1.74^{c}	142.50± 1.50^{c}	55.53±.35^{ab}
WB8%	121.57±1.70^{c}	151.65± .75^{d}	57.28±.74^{b}
WB10%	125.29±2.68^{c}	162.57± 1.40^{e}	62.09±.66^{c}

[a]mean value ± standard deviation
[b]mean value marked with different superscript in the same column are significantly different at Duccan - p≤ 0.05

Table 4: Proximate Composition of Formulated Biscuits Sample

Treatment	Moisture	Ash	Protein	Fat	Carbohydrate	Energy
WBB1	3.14±.15^{a}	2.73±.24^{a}	7.26±.15^{a}	22.17±.10^{a}	64.7	487.37
WBB2	3.43±.10^{b}	2.91±.07^{a}	7.60±.15^{b}	21.72±.27^{b}	64.34	483.24
WBB3	3.82±.18^{c}	2.85±.23^{a}	7.75±.07^{b}	21.57±.36^{b}	64.01	481.17
WBB4	4.94±.05^{d}	3.91±.04^{b}	8.03±.16^{c}	20.18±.04^{c}	62.94	465.5

[a]mean value ± standard deviation
[b]mean value marked with different superscript in the same column are significantly different at Duccan - p≤ 0.05

Table 5: Physical Properties of Biscuits with Different Percentage of Wheat Bran

Treatments	Weight(gm)	Diameter(mm)	Thickness(mm)	Spread Ratio (mm)	Spread Factor (%)
WBB1	9.78±.02^{b}	44.50±43^{a}	7.27±.05^{a}	6.12	100
WBB2	9.51±.22^{ab}	43.30±1.30^{a}	7.29±.04^{a}	5.93	96.89
WBB3	9.46±.05^{ab}	41.80±.26^{b}	7.32±.08^{a}	5.71	93.30
WBB4	9.03±.45^{a}	41.63±.37^{b}	7.01±.63^{a}	5.93	96.89

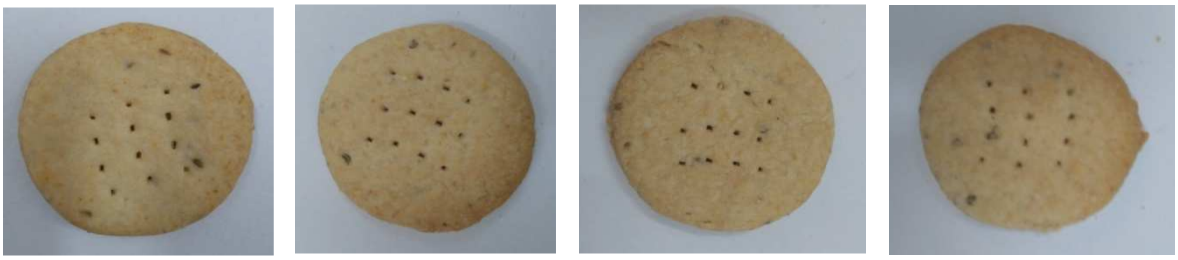
[a]mean value ± standard deviation
[b]mean value marked with different superscript in the same column are significantly different at Duccan - p≤ 0.05

Table 6: Organoleptic Characteristics of Biscuits

Treatments	Color	Taste	Texture	Flavor	Overall Acceptability
WBB1	7.66±0.16^{a}	7.81±0.10^{a}	7.60±0.10^{a}	8.10±0.10^{a}	7.76±0.057^{a}
WBB2	7.83±0.26^{a}	8.50±0.20^{b}	7.76±0.15^{ab}	8.06±0.05^{b}	8.40±0.10^{a}
WBB3	7.90±0.30^{a}	6.86±0.05^{c}	7.90±0.10^{bc}	7.10±0.10^{b}	7.80±0.10^{b}
WBB4	7.83±0.11^{a}	6.86±0.05^{d}	8.00±0.10^{c}	8.40±0.10^{c}	8.33±0.15^{b}

[a]mean value ± standard deviation

[b]mean value marked with different superscript in the same column are significantly different at Duccan - $p \leq 0.05$



Control **WBB6** **WBB8** **WBB10**

Figure 2

CONCLUSIONS

Biscuits containing wheat bran (6%, 10% and 8%) were highly acceptable. It could be concluded, that could be used as a suitable source of dietary fiber with associated bioactive compounds. It could be added as an ingredient in a wide variety of food products such as biscuits making.

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